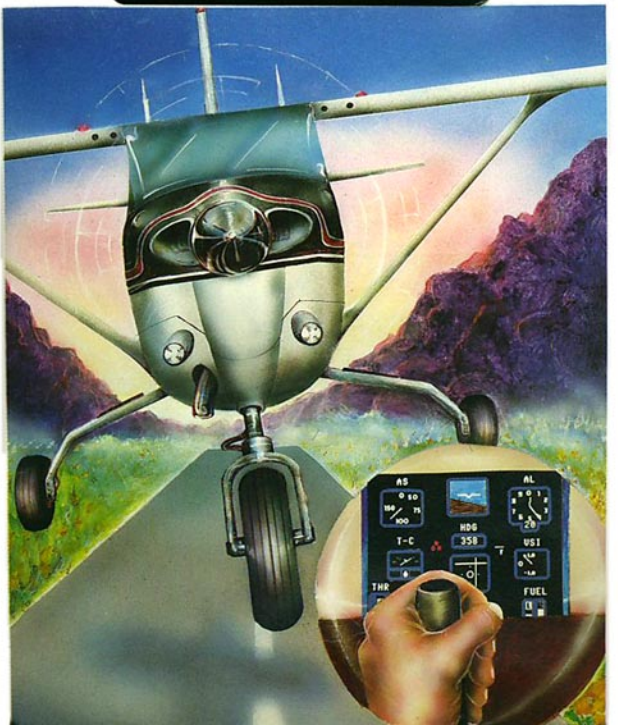
IFR

(FLIGHT SIMULATOR)

Commodore Plus/4
or Commodore 16



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PROGRAM EXPLANATION

This program simulates a flight in a light aircraft under Instrument Flight Rules (IFR). All instruments used for basic IFR flight are present: artificial horizon, airspeed indicator, altimeter, compass, vertical speed indicator, turn and bank indicator, tachometer, fuel gauge, glide slope, localizer, and flap and landing gear indicators, Distance Measuring Equipment, and Automatic Direction Finder.

In addition, this aircraft is equipped with a LORAN-C based inertial navigation system (INS). This is used with the map to navigate; finding airports and avoiding rising terrain.

The aircraft has performance approximately equal to a Cessna 172RG. This type of aircraft is certified in what is called the "normal" category; aerobatic maneuvers (loops, rolls, etc.) are prohibited, however, spins are allowed. If this aircraft is placed in an aerobatic attitude, that is, rolls over 60 degrees or pitch angle greater than 30 degrees, the primary instrument for instrument flight, the artificial horizon (also called the gyro horizon or attitude indicator), will become non-functional.

The objective is to safely fly to all four airports shown on your map, each having a different degree of difficulty. Your two full fuel tanks will last about 30 minutes, depending upon throttle setting, and may only be replenished at two of the four airports. Complicating your flight will be turbulence, narrow mountain passes, high saddlebacks, and tricky landing approaches.

At the conclusion of your flight, you will receive a scorecard of the number of airports you successfully landed at, and the total elapsed time of flight. As you become more proficient, try to fly the entire course in the minimum elapsed time.

IMPORTANT NOTICE:
While IFR (Flight Simulator) may help develop basic flying skills, it is not a substitute for actual flight training and is sold for entertainment purposes only.

LOADING INSTRUCTIONS

TAPE

1. Turn the computer off and then turn it back on.
2. Load the first program on side 1.
3. Type in RUN and press the RETURN key.
4. The entire program will require about 13 minutes to load.

DISK

1. Be sure the disk drive is turned on.
2. Turn off the computer and then turn it back on.
3. Insert disk in the disk drive with the label facing up.
4. Type LOAD "*",8 and press the return key.
5. When the word READY appears on your screen, type RUN and press the return key.

Plug the joystick into port #2.

In case of difficulty with tape:

The program is recorded on both sides of the cassette. Try loading the other side. If this does not work...

1. Rewind the tape to the beginning.

2. Without typing LOAD on the computer, press PLAY on the recorder and let the tape run to the end.

3. Turn the tape over and press PLAY on the recorder. Let the tape run to the end.

This procedure will allow the tape windings to conform to your individual recorder and should give you trouble free loading.

If the tape still does not load, try moving your recorder further away from your TV set and other sources of magnetic interference.

Any tape that does not load properly after these steps have been taken should be returned directly to Academy Software. We will promptly send a free replacemant under the terms of the limited warranty.

INSTRUMENTS

An explanation of each instrument follows:

COMPASS - The compass is located at the middle center of the instrument panel, labeled "HDG". The compass indicates the heading of the aircraft. North is 000, east is 090, south is 180, and west is 270. The direction the aircraft is actually flying may be different from the heading indicated on the compass due to crosswinds.

AIRSPEED - The airspeed indicator is located at the top left of the panel, labeled "AS". This indicates the speed of the aircraft in miles per hour. Since the airspeed indicator is a mechanical device controlled by air pressure, this gauge may lag the actual airspeed if airspeed is changing rapidly. This gauge is non-proportional – the needle moves slightly from 0 to 50 mph, then travels about 135 degrees to 100 mph, then a full 180 degrees to a maximum reading of 199 mph. The AS cannot indicate airspeeds above 199 mph.

ARTIFICIAL HORIZON - The artificial horizon (AH) is located in the top center of the instrument panel, and is the primary instrument used for IFR flight. The AH shows the position of the horizon relative to the aircraft. If the horizon is shown above the symbol of the aircraft in the center of the instrument, the aircraft is nose-down (in a dive). As is common for general aviation attitude indicators, the gyros of the artificial horizon will "spill" if the attitude limits of the instruments are exceeded. This is indicated by "FAIL" displayed in the center of the instrument. Incipient failure of the gauge is indicated by the airplane symbol turning red. The artificial horizon may only be repaired by landing at a major airport (airport #1 or #2).

ALTIMETER - The altimeter is located to the right of the artificial horizon, and is labeled "AL". The altimeter indicates the height of the aircraft above sea level. Note that it does not indicate the height above the ground – the elevation of the ground must be read off the map and subtracted from the altimeter value to determine the height of the aircraft above the ground. The small gray needle indicates the number of thousands of feet, and the large white needle indicates the number of hundreds of feet the aircraft is above sea level. The two digits below the altimeter indicate the last two digits of the actual altitude. Therefore, if the small needle is halfway between the five and the six, and the two digits on the bottom are 35, the altitude of the aircraft is 5,335 feet above sea level.

LANDING GEAR - Three small lights showing the status of the retractable landing gear are located just to the right of the airspeed indicator. When the landing gear is down, the three lights are white (bright on a black-and-white TV). When the gear is up, the lights are red (dim on a black-and-white TV). When the gear button is pressed, the landing gear lights flash red and yellow, indicating that the gear is transitioning to the alternate position. The gear is not safe to land on unless the lights are white.

FLAPS - The flap indicator is located under the altimeter, and is labeled with a small "F". This indicator graphically shows the position of the wing flaps.

TACHOMETER - The tachometer is a large vertical bar graph on the left side of the instrument panel, labeled "T". The tachometer shows the engine power setting.

FUEL GAUGES - The fuel gauges are the other two vertical bar graphs on the right side of the instrument panel, labeled "F". The two bar graphs are labeled L and R, and indicate levels in the left and right fuel tanks. The L or R will light up to indicate which fuel tank is currently in use. The rate of use is directly proportional to throttle setting, so if you are low on fuel, keep the throttle setting low. You receive a full tank of fuel whenever you land at a major airport.

ILS - The instrument landing system instrument is located in the center of the instrument panel below the compass. This instrument indicates the position of the aircraft relative to the approach path of an ILS-equipped runway.

ILS STATUS INDICATORS - Four indicators are located below the ILS instrument. The first indicator shows which ILS station is currently tuned in, and the indicators labeled O, M, and I indicate when the Outer, Middle, and Inner marker beacons are passed on an ILS approach.

VERTICAL SPEED - The vertical speed indicator (also called the rate of climb indicator) is located above the fuel gauge and below the altimeter, and is labeled "VSI". This instrument shows the rate at which the aircraft is climbing or descending. The needle pointing directly left indicates that the aircraft is neither climbing nor descending. If the needle is pointing straight up, the aircraft is climbing at 1000 feet per minute (fpm), if pointing straight down, the aircraft is descending at 1000 fpm. Other climb or descent rates may be inferred from the position of the needle; i.e., 45 degrees up on the upper left side is 500 fpm up, 45 degrees down on the lower right is 1500 fpm down, etc.

TURN INDICATOR - The turn indicator is located below the airspeed and above the tachometer. You may select the type of indicator desired – Turn and Bank (labeled T&B), which uses a vertical bar to indicate direction and amount of turn, or Turn Coordinator (labeled T-C), which displays a small airplane symbol to indicate direction and amount of turn. The turn indicator can be used to make precision turns. Using the T&B, the needle points in the direction of the turn relative to the amount of bank. With the needle overlapping the left or right markers, the aircraft will be in position for and will perform what is known as a standard rate turn. If the T-C is in use, the wings of the small airplane will point at either of the lower markers if the same turn rate is performed. The turn indicator becomes useful if the gyros of the artificial horizon are "spilled," as the wings can be leveled and the aircraft flown to the nearest major airport using the turn indicator. Upon initial startup, the Turn Coordinator is selected.

INS - The inertial navigation system readout is located at the very bottom of the screen. The current aircraft position, as listed by the INS display, can be compared to the map to determine the current position of the aircraft. The N value increases as you fly toward the north, and decreases as you fly south. The W value works the same way; increasing as you fly west and decreasing as you fly east. These values increase and decrease in the same manner as latitude and longitude values increase and decrease on an aeronautical chart in North America.

AUTOMATIC DIRECTION FINDER - The Automatic Direction Finder, labeled ADF, is located to the left of the fuel gauges. When the needle is centered between the two markers, the aircraft is flying directly to the ADF station which has been selected, as indicated by the letter or number below the instrument.

DISTANCE MEASURING EQUIPMENT - The Distance Measuring Equipment, labeled DME, is located to the right of the tachometer. The DME indicates the straight line distance, in miles, to the airport selected for the ILS.

CONTROLS

JOYSTICK

The joystick is used to control aircraft attitude. Pull back on the stick to bring the nose of the aircraft up, push forward for nose down, left for left bank, and right for right bank. In some instances, the joystick will have little or no effect. For instance, if the aircraft is stationary on the ground, movement of the stick is useless. If the aircraft is on the ground and moving, this stick can be used to bring the nose up; however, the effectiveness of this action depends upon the speed of the aircraft. Note that you still cannot bank left or right until the aircraft has taken off.

Once the aircraft has taken off, all controls work normally, unless the aircraft is spinning or has suffered structural failure.

For precise control, normal stick movement brings a rather sedate response of the aircraft. For faster maneuvers, press the FIRE button of the controller while moving the stick. This increases control response.

Note that when the aircraft is banking, the pitch control (nose up and down) is less effective, depending upon the amount of bank.

KEYBOARD

Other than attitude control, all functions of the aircraft are controlled by the keyboard. The following is an explanation of key function:

KEY	FUNCTION
f1	Throttle control. f1 quickly increases the throttle setting.
f3	Throttle control. f3 slowly increases the throttle setting.
f5	Throttle control. f5 slowly decreases the throttle setting.
f7	Throttle control. f7 quickly decreases the throttle setting.
Q	Nose down trim. If the aircraft tends to climb when the attitude indicator shows level, press Q until climbing tendency stops.
A	Nose up trim. If the aircraft tends to dive when the attitude indicator shows level, press A until the diving tendency stops.
I	Tunes the ILS between airports #1 and #2. The ILS station currently tuned in is indicated by indicator below the ILS instrument.
R	Tunes the ADF to ADF stations A,B,C,D, and airports #1 and #2. Each time you press R, the ADF switches to the next station. If it was tuned to airport #2, it switches to station A.
G	Operates the landing gear. Press G to retract the landing gear, then press G again to lower the gear. Switches mounted on the landing gear prevent retraction while aircraft is on ground.
T	Switches fuel tanks.
B	Wheel brakes. Press B to slow the aircraft when on the ground. Brakes do not work while flying.
,	Nosewheel steering. Turns aircraft to left when on ground.
.	Nosewheel steering. Turns aircraft to right when on ground.

(Note that the , and the . keys have < and > also printed on them. Use this to help remember their function.)

P	Pause. Press P to "freeze" action. Press any key to start again.
@	Raises wing flaps.
;	Lowers wing flaps.
X	To end and receive scorecard.

All keys repeat, so just hold down a key if continued function is desired.

AIRCRAFT SPECIFICATIONS

STALL SPEED (FLAPS UP)	56 MPH
10 DEGREES FLAPS	54 MPH
20 DEGREES FLAPS	52 MPH
30 DEGREES FLAPS	50 MPH
40 DEGREES FLAPS	48 MPH
Vne (RED LINE SPEED) GEAR UP	220 MPH
Vne GEAR DOWN	180 MPH
(Subtract 5 mph from red line speeds for each 10 degrees of flaps)	
APPROACH SPEED	85 MPH
BEST RATE OF CLIMB SPEED	90 MPH
BEST ANGLE OF CLIMB SPEED	75 MPH
CRUISE SPEED (60% POWER)	130 MPH
ENDURANCE (60% POWER)	30 MINUTES
ABSOLUTE CEILING	10,000 FEET
TAKE OFF DISTANCE	600 FEET
LANDING DISTANCE, NORMAL APPROACH	700 FEET
LANDING DISTANCE, SHORT FIELD APPROACH (FULL FLAPS, 65 MPH APPROACH SPEED)	225 FEET

THIS AIRCRAFT IS CERTIFIED IN THE NORMAL CATEGORY, AND IS SUBJECT TO THE FOLLOWING RESTRICTIONS:

MAXIMUM BANK ANGLE	60 DEGREES
MAXIMUM DIVE OR CLIMB ANGLE	30 DEGREES

SPINS PERMITTED

INITIALIZATION

Upon start-up, the 64 will require input of a skill level between 0 and 9. 0 is easiest; 9 hardest. Input the desired skill level by pressing the appropriate key. The skill level entry affects the following parameters:

1. The amount of wind.
2. The maximum allowable rate of descent at landing. With skill level of 0, the maximum allowable rate of descent for a successful landing is 500 fpm (vertical speed indicator pointing down at 45 degrees). With skill level 9, max allowable rate of descent is 320 fpm.
3. The maximum allowable airspeed at landing. If this speed is exceeded on touchdown, the aircraft will bounce. Max speed for skill level 0 is 75, max for skill level 9 is 66.
4. The maximum altitude for a successful full-stall landing. With a skill level of 0, you may stall the airplane 15 feet off the ground and still land successfully, with skill level of 9 you must stall below 6 feet.

After skill level has been entered, the 64 will ask for a turbulence value between 0 and 9. Turbulence is the "bumpiness" of the air, caused by wind gusts. Turbulence will change the attitude of the aircraft, while the "bump" will cause you to lose track of the instruments momentarily. The higher the turbulence value, the more often the aircraft will be upset by turbulence.

The 64 will then print out the current wind direction and speed, and clear you for take off. Press T to take off, or E to enter the editor. The editor is used to set up the aircraft in a particular flight position or to change turn indicator type. If you enter the editor, the current values for all parameters will be displayed, and you may change them by typing in the desired value and pressing "RETURN". The following chart gives the minimum and maximum allowable entries, as well as sample entries to set up the aircraft on airport #2:

PARAMETER	MINIMUM	MAXIMUM	AIRPORT #2
ALT (altitude)	0	9999	40
N (INS position)	0	255	200
W (INS position)	0	255	200
AS (airspeed)	0	180	0
THR (throttle)	0	32	1
FUEL	0	24	24
HDG (heading)	0	359	270

If you use the editor to set up an in flight condition, be sure to enter an AS above the stall speed, or the aircraft will stall immediately. If you set up the aircraft for a location and enter an altitude below ground level. the aircraft will automatically be placed at the height of the terrain.

BASIC FLIGHT

To take off, press the f1 key to increase throttle to maximum. The aircraft will start rolling, as shown by the airspeed indicator. When airspeed reaches 55, pull back on the stick to bring the nose slightly above the horizon. If you bring the nose up far enough before takeoff speed (56 mph) is reached, the aircraft may take off, but will immediately stall and drop back to the runway. With normal procedure, the aircraft should lift off when airspeed reaches approximately 65 mph. When the aircraft is off the ground, as indicated by the altimeter, press G to retract the landing gear. Keep the nose slightly above the horizon until airspeed reaches the best rate of climb speed of 90 mph (about the last 0 on 100). Then, ease the nose up to hold the airspeed constant. Whenever the throttle is held constant, airspeed is controlled by the aircraft pitch angle – increase pitch angle (bring the nose up) to decrease airspeed, and vice versa.

As you fly north, you will begin to hear the morse tones of the ILS marker beacons. If this is annoying, press "I" to change ILS tuning to airport #2. As you are out of ILS range for airport #2, the tones will then stop.

When you are 400 feet above the ground, ease the stick to the left to start a left turn. Release the stick when the turn indicator shows a standard-rate turn (needle 45 degrees left or small airplane's right wing aligned with lower marker). Watch the compass (HDG) and stop the turn by pushing the stick to the right to level the wings when heading is 270 degrees. Note that, since you are flying due west, the W value on the INS is increasing, and the N value is nearly stable. When altitude is equal to 600 feet, push the stick forward to bring the nose down to the horizon. Note that the airspeed will now increase. As the airspeed reaches 120 mph, press f5 or f7 to bring the throttle down to between ¼ to ¾ maximum. Airspeed should stabilize at about 130 mph.

If the artificial horizon shows that the airplane is level, but the altimeter and/or VSI show the aircraft climbing or diving slightly, use nose-down or nose-up trim, as appropriate, to maintain altitude.

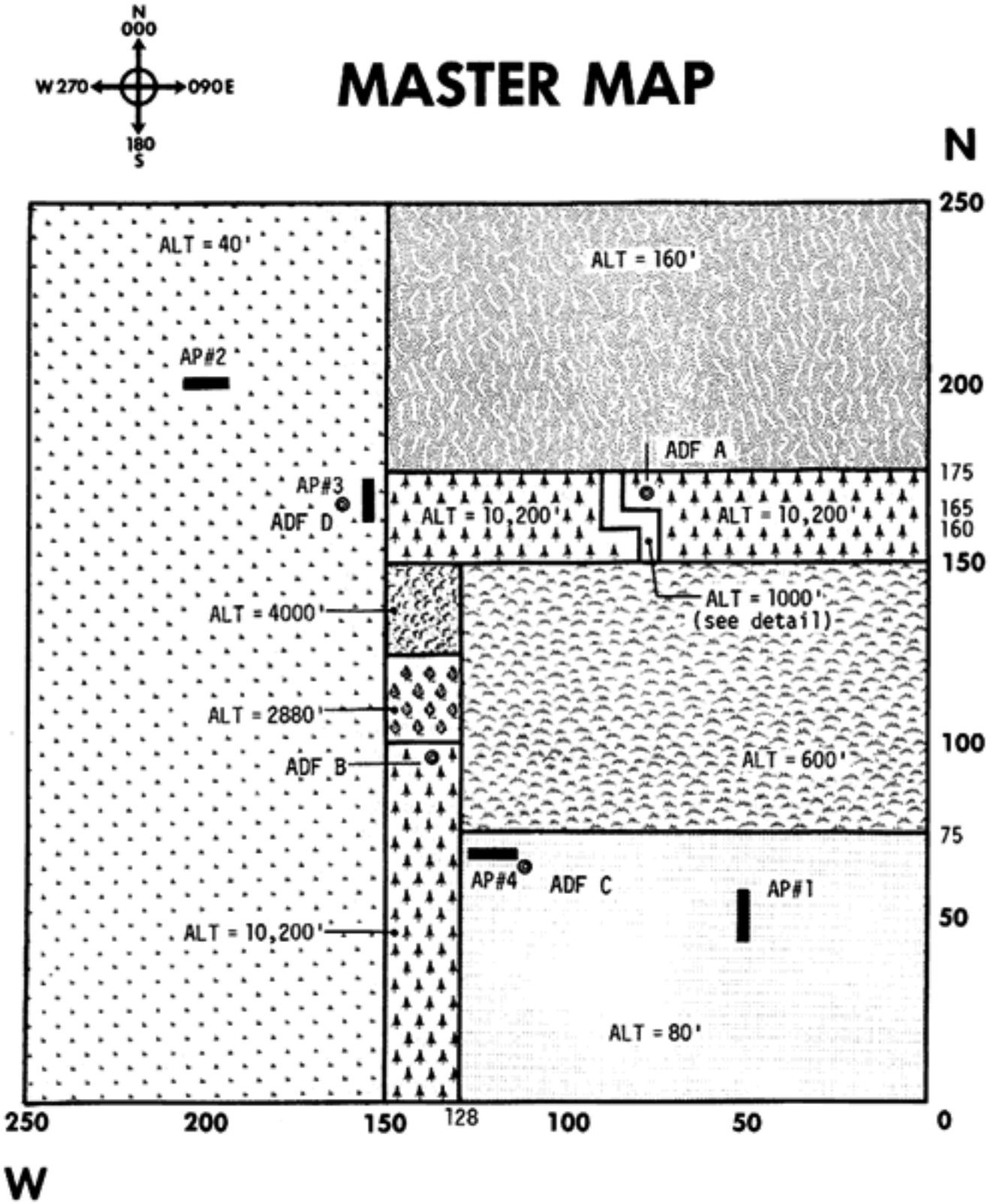
Experiment to determine the flying qualities of the aircraft. Start a standard-rate turn to the left, and note that the airspeed will stay constant, but the altitude will slowly decrease. To stop this descent, pull back on the stick until the descent stops. In a bank, the lift vector of the wings no longer directly opposes gravity, so the aircraft sinks. By pulling back on the stick, lift is increased and the sink is arrested. Note, also, that the nose does not come above the horizon when you pull back on the stick in a bank as fast as if the aircraft were flying level. Keep all this in mind while flying close to the ground (as in landing), for if you try to turn at low altitude, you may sink into the ground unless you apply back pressure to the stick.

By pressing the fire button on the joystick, the aircraft responds more quickly to the controls. Press the fire button and move the stick to the right to level the wings, and the aircraft responds much more quickly. Use the fire button when you must turn quickly to catch the ILS localizer or to pull up fast from a dive. More precise control is possible with the fire button released; so don't use it while flying precision approaches.

To examine the stall/spin characteristics of the aircraft, use the f7 key to bring the throttle all the way off. Note that the engine will still be idling, so engine power is still available. Keep the nose level, and watch the airspeed drop. When the airspeed reaches about 70 mph, a tone will sound, warning that you are approaching the stall speed. Although the airspeed indicator may lag the actual airspeed, the stall warner is activated by a special switch on the wing which senses the airstream and will not give false readings.

The aircraft will stall in the current configuration (flaps up) at 56 mph. When the aircraft stalls, a wing will drop, the nose will dip well below the horizon, and the aircraft will go into

MASTER MAP

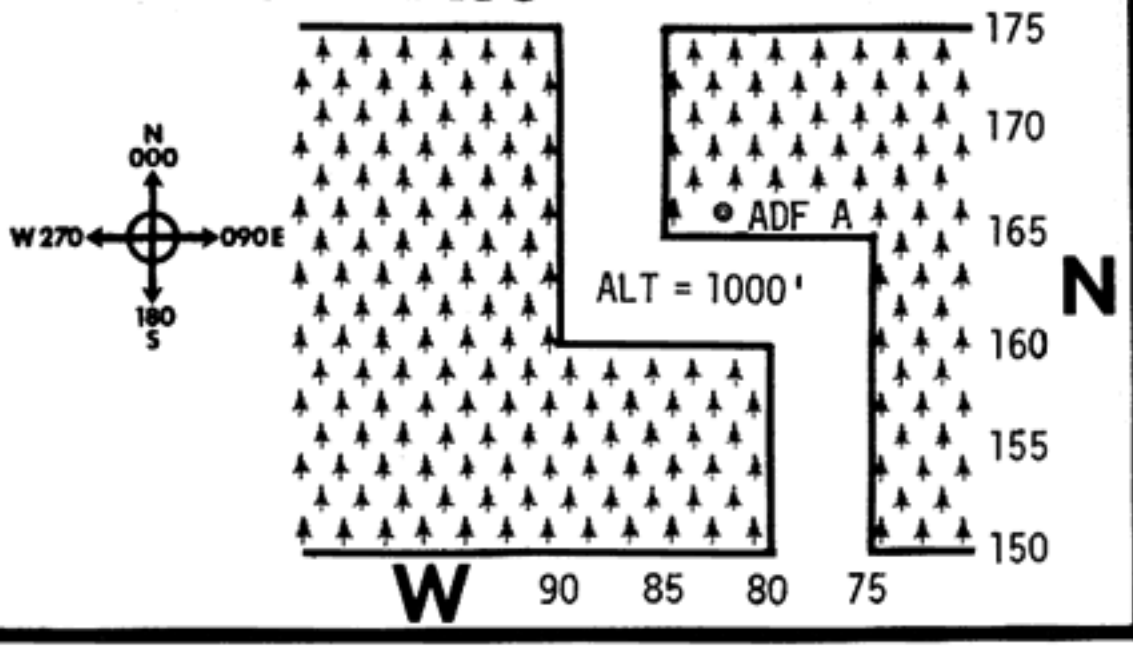


ADF LOCATIONS

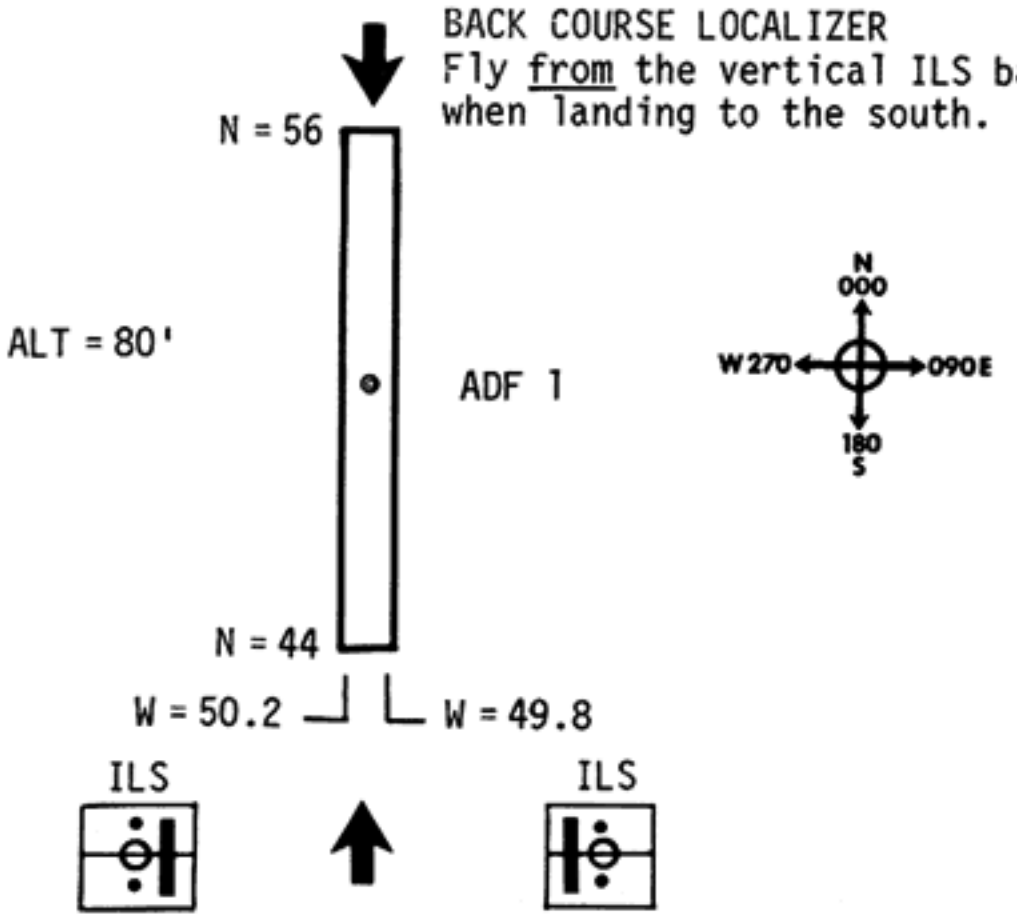
A	N165, W083	C	N070, W115
B	N100, W138	D	N166, W154

SEE FURTHER MAPS FOR AIRPORT DETAILS

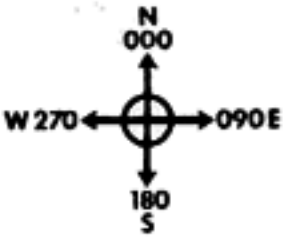
DETAIL OF PASS



AIRPORT #1



AIRPORT #2

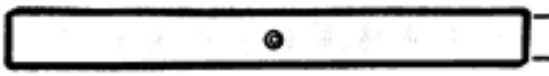


N = 200.2

FRONT COURSE APPROACH
Fly <u>to</u> vertical bar when landing to the east.

W = 205

W = 195



ADF 2

N = 199.8

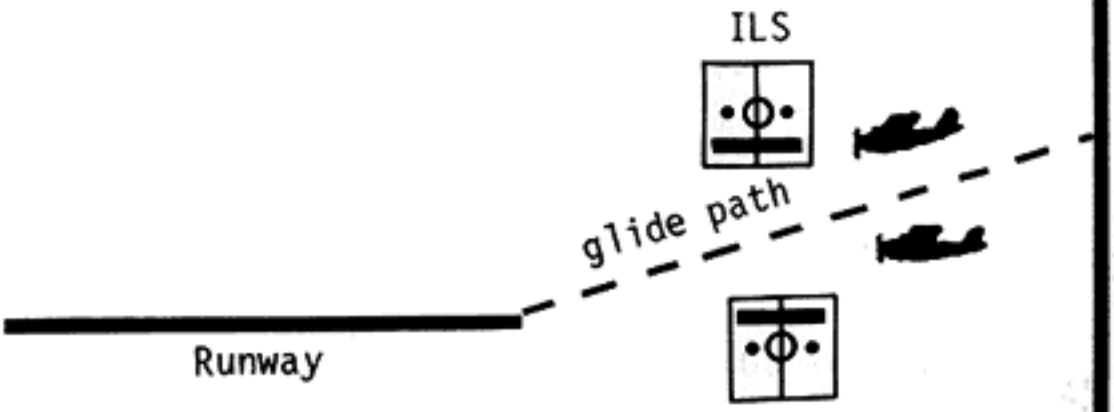
BACK COURSE APPROACH
Fly <u>from</u> vertical bar when landing to the west.

ALT = 40'

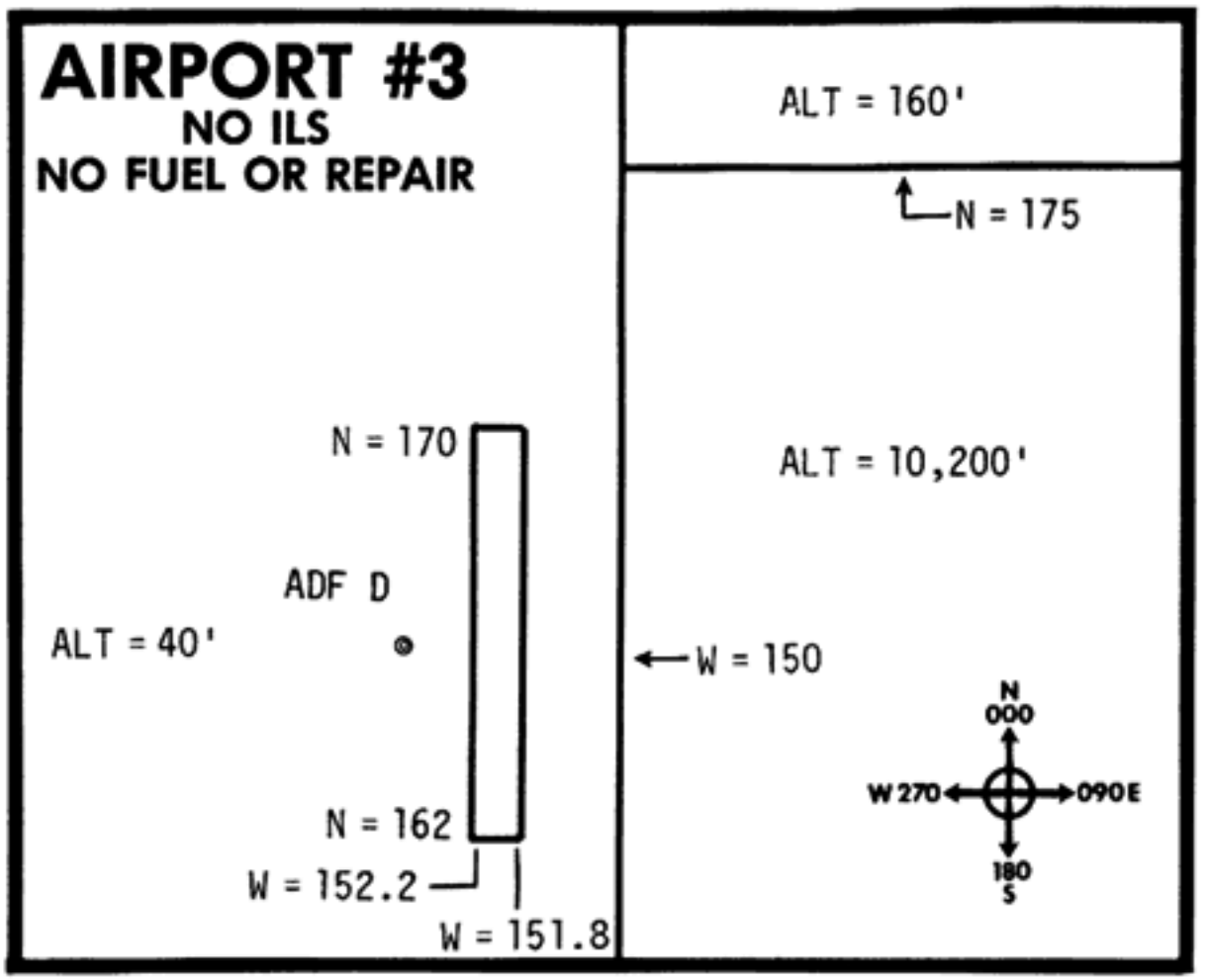
TO FLY GLIDESLOPE:

The Glideslope is the horizontal bar on the ILS. Fly to the bar to get on Glideslope for either front or back course approach.

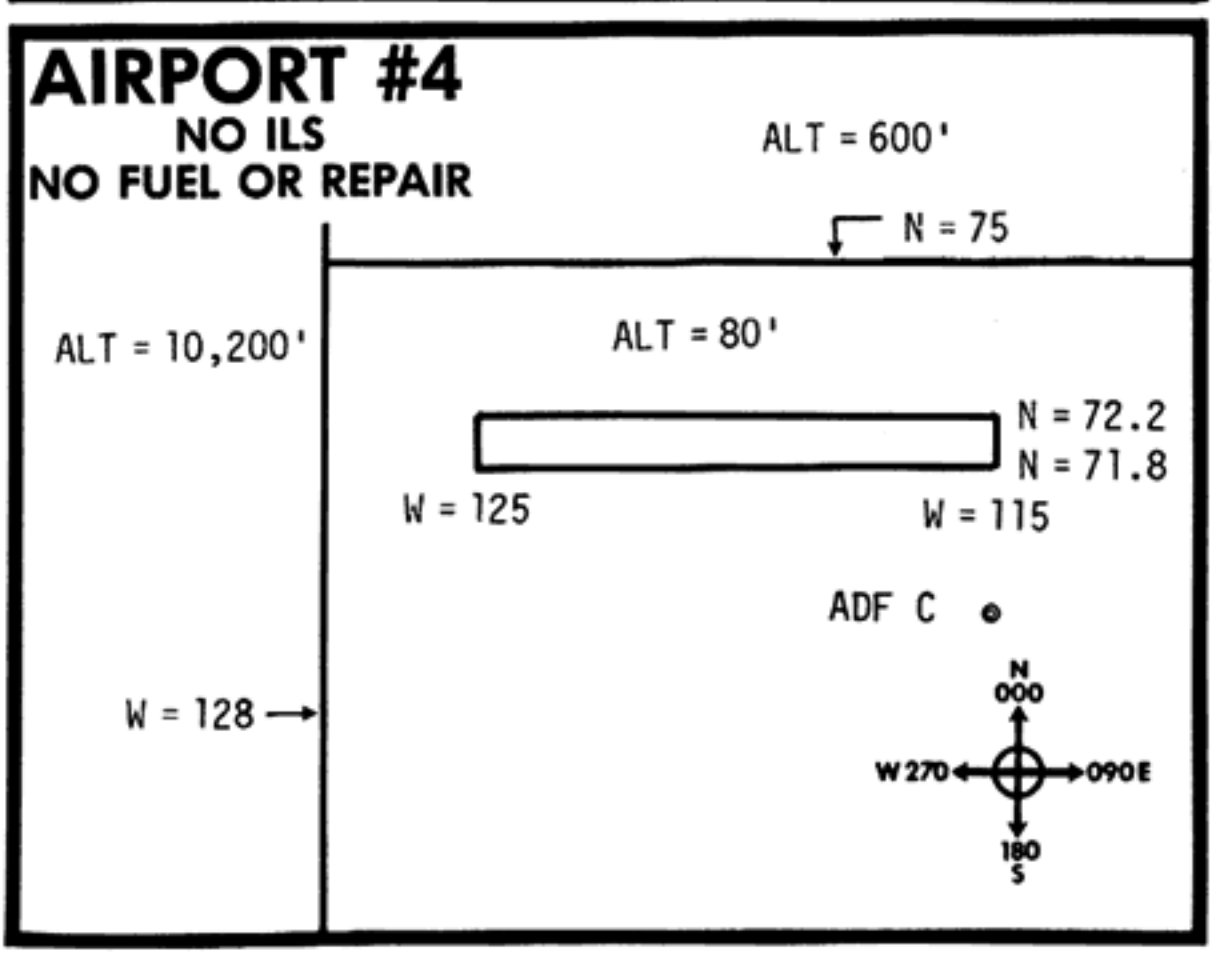
Note: Touchdown must occur with a descent rate less than required for skill level.



AIRPORT #3
NO ILS
NO FUEL OR REPAIR



AIRPORT #4
NO ILS
NO FUEL OR REPAIR



a spin, as seen by the changing heading. Note that nose-up stick (pulling back) and left or right stick have no effect on the aircraft attitide. Airspeed remains at about 55 mph or less.

What has happened is that the aircraft is no longer flying fast enough for the wings to support the weight of the aircraft, so the aircraft is falling. As the plane is flying so slow, controls have little effect on its attitude. In fact, if you have not yet recovered from the spin, you will have crashed into the ground by now. OOPS . . . that's right, I haven't told you how to recover yet . . .

Press any key to get started again, and press 0 for both skill level and turbulence. When cleared for takeoff, press the Quick Edit ↑ key. This will set the aircraft up as follows:

ALT 5000
N 50
W 50
AS 115
THR 22
FUEL
  LEFT 24
  RIGHT 24
HDG 000

Now you will start out at 5000 feet, plenty of room to experiment with stalls and spins.

Enter the spin using the procedure explained earlier. To recover from the spin, you must increase airspeed to above stall. You do this, of course, by pushing forward on the stick to (even further) lower the nose. As soon as the spin ends (HDG will remain constant and airspeed will start to increase) press the fire button to increase control response, level the wings, and pull back to level out. Don't forget to add power to keep from stalling out again, once you are level. Notice that you have lost quite a bit of altitude. You may, at some future time, deliberately enter a spin to lose altitude quickly without gaining airspeed.

Experiment with stalls and spins for a while and you will discover the following:

1. Your stall speed increases in proportion to bank angle. Once again, banking causes the lift vector of the wings to no longer directly oppose gravity, so stall speed is increased.

2. Stall speed decreases with flaps. Lower your flaps using the ; key, and your stall speed may drop as low as 50 mph.

3. Throttle setting has little effect on stall. The aircraft will stall at the same speed whether the throttle is at idle or full. Throttle position will affect the pitch angle at which stall occurs.

The stall warning horn will always sound at least 10 mph before the stall occurs. Press the X key while the plane is in the air to end this flight.

Flap Use

Flaps are useful in many ways. One, as you have seen, is lowering the stall speed. Flaps also add drag to the aircraft, and so are useful for slowing up quickly and/or losing altitude without gaining excessive speed. The flaps have five positions: Up, and 10, 20, 30 and 40 degrees down. Note that as flaps come down, the nose must be brought up and power increased to remain at the same altitude. At the full flap setting, full power and a considerable nose up angle must be applied to keep altitude constant. If you do not add power, you must push the nose down to maintain flying speed.

Red Line Speed

Red line speed (officially called Vne, or the never exceed speed), is the speed at which the force of the air will literally rip the wings off. Should you exceed this speed, a roaring sound will be heard, and the aircraft will become completely uncontrollable. Red line speed is 220 mph with landing gear up and 180 mph with gear down. Subtract 10 mph from the given red line speed for each 10 degrees of flaps.

Landings

You may land anywhere you wish, provided you do not fly into the side of a cliff while doing so. There are four airports on the map, two with ILS capability and two without. You may land off airport, but there is a chance of hitting a tree or other obstruction once you have landed. Specific information on landing at airports is contained in later sections. The following is generic to all landings:

To land successfully, you must touch down with a rate of descent of 500 feet per minute or less, depending upon skill level entered. A 500 fpm descent is shown on the rate of climb instrument as the needle pointing 45 degrees down to the left. Set up for the landing by lowering your landing gear, bringing back the throttle to about ¼ full, and assuming a glide at about 80 mph. As the aircraft approaches the ground, bring the nose up to both decrease the rate of descent and the airspeed. Look out for the stall speed! If you approach stall, either push the nose down or increase power. Once you are within 15 feet of the ground (or less, depending upon skill level selected), level the wings, pull the power off all the way, and ease back on the stick. Do not pull the nose up far enough to gain altitude, just bring it up to cut down on the rate of descent and to stall the aircraft. If you landed successfully, the word "LANDED" will flash on the screen and a high tone will sound. If you have not landed on the runway, a low tone will start and the words "OFF RUNWAY" will continuously flash on the screen. In any case, use the nosewheel steering to control the aircraft and the brakes to bring it to a halt.

If you come to a halt on either airport #1 or airport #2, you will receive full fuel, and your artificial horizon will be repaired, if it was damaged.

You will only receive credit for landing at a particular airport if your initial touchdown was on the runway. If you touch down off runway and taxi on to the runway, it will not count for credit! However, if you are on airport #1 or airport #2, you may still receive full fuel. A full stop landing is necessary to receive fuel, but you can be credited for a landing without stopping – by executing a "touch and go". After the aircraft has initially touched down, add full power for takeoff immediately.

If you land with airspeed greater than 75 mph (or less, depending upon skill level selected), the aircraft will bounce, bringing its nose up and starting to climb. If you land while turning too steeply, or with the nose down too far, you will crash.

If the fuel tank you are using runs out, switch to the other fuel tank by pressing "T", and start the engine by pressing any throttle key.

USING THE MAP

Use the Inertial Navigation System (INS) readout at the bottom of the instrument panel for your N and W position. Using the map, find the W value on the horizontal axis and trace upward to the same level on the vertical axis as your N value. Each unit on the INS is equivalent to approximately 1/10 of a mile.

Check the level of the terrain in your location, If your altitude matches this level, you will either land or crash, depending upon whether the landing criteria are met.

Some of the major features of the map are:

Four airports:

Airport	N	W	Direction	Airport Altitude
#1	50	50	north-south	80 feet
#2	200	200	east-west	40 feet
#3	166	152	north-south	40 feet
#4	72	120	east-west	80 feet

The N and W values shown for the airport location is the very center of the runway. The direction shown above is the long direction of the runway. The runways at airports #2 and 4 are a total of 10 INS units (1 mile) long, airport #3 is 8 INS units long, and airport #1 has a runway 12 INS units long. The runway at airport #2, for instance, runs from W = 195 to W = 205, a total of 10 INS units long. All runways are .4 INS units wide, or .2 INS units on either side of the runway centerline. Therefore, the width of the runway at airport #4 runs from N = 71.8 to N = 72.2.

Four ADF stations are located as follows:

ADF Station	N	W
A	165	83
B	100	138
C	70	115
D	166	154

Two more ADF stations are located with the ILS equipment of airport #1 and airport #2. When tuned to ADF station "1" or "2", the ADF station is, essentially, located in the center of the airport.

ADF stations can be relocated while in the edit mode by pressing shift R when cleared for takeoff.

Other features of the map include:

A plateau, starting at N = 75 for W = 0 to W = 128, and ending at N = 150.

A mountain range shaped like an inverted "L", located in the center of the map. There are two ways through the range:

A sideways "Z" pass in the north side of the range, minimum altitude 1000 feet.

A high pass, minimum altitude 2880 feet rising to 4000 feet on the eastern side of the range.

ILS APPROACHES

The ILS is used to make precision landings at airports #1 and #2. Select the ILS for the airport you are flying to by pressing 'T. The ILS transmitter at each airport has a range of approximately 3 miles.

The horizontal bar is called the glide slope, and the vertical bar is called the localizer.

The glide slope shows the relative vertical position of the aircraft in relation to the proper glide path. If the bar is beneath the center, the aircraft is above the glide path, so you must lose altitude more quickly. If the bar is above the center, you are too low, and must bring the aircraft up to meet the glide path.

The localizer shows the relative position of the aircraft in relation to the centerline of the runway. There are two types of approaches: front course localizer, and back course localizer.

You will be flying a front course localizer approach if you approach airport #1 from the south or approach airport #2 from the west. On a front course approach, the vertical bar will be to the right of center if you are to the left of the centerline, and vice versa. So to keep the localizer bar centered, you must fly "towards" the bar.

You will be flying a back course localizer approach if you approach airport #1 from the north or airport #2 from the east. On a back course approach, the vertical bar works opposite from the front course – the bar is left of center if the aircraft is left of centerline, and vice versa. Fly "away" from the bar on a back course localizer approach.

Below the ILS instrument are three indicator lights, labeled O, M, and I, and are the Outer, Middle, and Inner marker lights. The Outer marker light comes on when the aircraft is 3 miles from the closest edge of the runway (runway threshold), the Middle marker will come on 2 miles out, and the Inner marker comes on 1 mile from the runway threshold. Each marker is also identified by a distinctive code signal.

The ADF and DME are also used for ILS approaches. The DME is used to determine how far the aircraft is from the runway. Tune the ADF to the proper airport by pressing "R" until the airport number is shown below the ADF instrument. If the ADF needle is then held in the center of the instrument, the aircraft will be flying within 10 degrees of the proper heading for the airport. As the aircraft gets closer to the airport, you will have to control heading more precisely to maintain a centered ADF needle.

The localizer and glide slope bars work on an angle offset method for determining display output, so, as the aircraft approaches the airport, a slight offset from the proper path will result in a greater display offset as the aircraft gets closer. By the time the Inner marker light comes on, the aircraft is so close to the runway that the ILS bars will be wildly swinging at the slightest error from the proper path. Therefore, when the Inner marker light comes on, you should start cross-checking the ILS reading with the altimeter and INS. As the aircraft nears the runway, the ILS should be ignored as it starts to swing quickly. Complete the landing using the altimeter and vertical speed indicator to control descent, lining the aircraft up on the runway centerline using the INS readout. Land the aircraft as described under "Basic Flight."

To fly a practice ILS approach, press the Quick Edit * key when cleared for takeoff, which will set the aircraft up as follows:

```
ALT 700
N 15
W 50
AS 90
THR 16
FUEL
  LEFT 24
  RIGHT 24
HDG 000
```

This will set you up 3 miles south of the runway threshold for airport #1, heading towards the runway. As you fly north, the ILS bars will appear on the instrument as you get within range of the ILS transmitter on the airport. You are set up for a front course localizer approach, so fly toward the bars to stay on the glide path and localizer. Depending upon the wind, you may have to "crab" the aircraft into the wind (that is, point the nose of the aircraft slightly to the left or right of the direction of the runway) to maintain the localizer bar centered. When the Inner marker light comes on, start lining the aircraft up with the runway using the INS display, as described earlier.

The "Trick" to ILS approaches:

If you are flying the approach as described above, you will find that it is usually easy to keep the aircraft on the glide path, but you will have trouble keeping the localizer centered. This is because the localizer displays only the angle of offset from the centerline of the runway; aircraft heading does not affect the localizer. Therefore, if your W value is 50.0, and your heading is 090, the localizer bar will be centered, But, as you are flying at right angles to the proper approach, the localizer bar will rapidly move off to the left as you continue flying. So, for a few seconds the ILS would have shown a perfect approach, while in reality you were not set up for an approach. The trick is to center the localizer bar and the ADF needle at the same time. In the previous example, when the aircraft W position reads 50.0, the aircraft heading should be approximately 000 and ADF centered, if 0 was entered for skill level.

Let's fly a complete IFR flight. Start the program without entering the editor. Apply full power by holding down the f1 key. When airspeed reaches about 55 mph, pull back on the joystick to bring the nose slightly above the horizon, as shown by the artificial horizon. When the altimeter shows that you have taken off (reads greater than 80 feet), press 'G' to retract the landing gear. Turn left to a heading of 270 and, when airspeed reaches 90 mph, bring up the nose further to hold the airspeed constant and maximize climb rate. You are now on what pilots call the "crosswind leg". Turn left to a heading of 180 when W reaches about 75. You are now on the "downwind leg" of your approach. When altitude reaches 600 feet, push forward on the stick to level off, and use the f5 or f7 key to bring the throttle back to between ½ to ¾ full. Try to fly so that W remains constant. To do this, you may have to "crab" slightly to the left or right. Airspeed, by now, should have stabilized between 125 and 140 mph. Fly south (heading 180) until N reaches about 20, then turn left to a heading of 090, or east. You have just turned onto the "base" leg, and things will start getting tricky. Make sure that your airspeed is less than the Gear Down Redline speed (180 mph) and press 'G' to lower your gear. Verify that the gear is down by the landing gear lights, and notice that the drag of the gear has lowered your airspeed somewhat. Verify that your ILS is tuned to airport #1 using the ILS selection indicator. Note that you are still too far away from the airport to receive ILS signals. In addition, tune the ADF to airport #1. As W decreases past 60, get ready to turn left for your final approach. When W reaches 55, turn left to a heading of 000 (north). Once again, try to end up with W approximately 50 at the same time your heading reaches 000, and the ADF needle is in the center; however, this far away from the airport, you don't have to be really accurate; when the DME indicates 4 miles to the airport, you should pick up the ILS signal. You are on the front course localizer approach to airport #1, so fly to the vertical bar to center yourself on the localizer, and fly to the horizontal bar to achieve the proper glide path angle. Decrease airspeed to about 100 mph by reducing the throttle setting. Keep on the localizer and glide path as you approach the runway. When the Outer marker light comes on, pull back the throttle even more to reduce airspeed to 90 mph, and make sure that your landing gear is down.

If you are well above the glide path, try adding some flaps to increase your rate of descent. When the Middle marker light comes on, drop airspeed to 75 mph and attempt to hold it there. When the Inner marker light comes on, center the aircraft on the runway using the INS display. All runways are .4 units wide (in reference to the INS), so the runway extends in width from 49.8 to 50.2. You will probably note that the rate of descent exceeds 500 fpm, so pull back on the stick to check the descent. Watch your airspeed, though, and add power if you think you might stall. When N is greater than 44, you have passed the runway threshold, and you may now let the aircraft descend to the ground. Make sure that your wings are level, that your nose is at the horizon or higher, and your airspeed is 75 mph (or less, depending upon skill level) before letting the aircraft touch down. Use the nosewheel steering to keep on the runway, and press 'B' to apply brakes and stop.

NON-ILS APPROACHES

Airports #3 and #4 do not have ILS. To fly into these airports, you must use the 'poor man's ILS' method, using the INS and altimeter. Set yourself up on final, about 3 miles away from the runway (30 units on the INS). If the airport runs north-south (airport #3) keep the W value equal to that of the centerline of the runway; if the runway runs east-west, keep the N value equal to that of the runway centerline. Lose altitude until you are about 100 feet above the runway elevation, and fly at an approach speed of about 85 mph. When you are about .5 INS unit from the start of the runway, start a descent to the runway, and land just as if you had been flying an ILS approach.

ADF stations are located near the two airports without ILS, but note that these stations are offset from the actual runways. You may use the ADF to help set a course to these airports, but when you get near the airport, the ADF will be useless.

OFF AIRPORT OPERATIONS

If you taxi off the runway, just use the nosewheel steering to get back. However, should you land off the runway, you have two choices:

1. Use the nosewheel steering to taxi to the nearest runway.
2. Immediately take off and fly to the nearest airport. There is a chance, whenever you are not on a runway, of hitting an obstacle. If you are near the airport, you may take a chance of trying to taxi to the runway, however, you will not receive credit for landing on the runway if you use this method.

If you decide to take off, note that the ground is quite 'sticky'; you will find that the aircraft accelerates sluggishly when you apply full power. Hold the nose down until you reach 58 mph, then pull back sharply on the stick to bring the nose well above the horizon and 'pop' the aircraft off the ground. Punch 'G' to retract the gear, and push forward on the stick to bring the nose to just above the horizon and keep from stalling. Note that 58 mph is just 2 mph above stall, so apply that forward stick fast! Actually, don't worry too much, because if you stall, the aircraft will land and you'll get to try again (assuming, of course, that you haven't yet retracted the landing gear). However, don't push forward too vigorously, or you may impact the ground with the nose too low and crash!

HINTS

The aircraft contains sufficient fuel to take off from airport #1, touch and go at airport #4, and fly to airport #2. Land full stop to refuel, then take off for the flight back to airport #1, doing a touch and go at airport #3 on the way. However, this requires moderate flying ability, so you may wish, at first, to operate in stages – take off from airport #1, touch and go at airport #4, and fly back to airport #1 for fuel. Then, fly to airport #2, land and refuel, then fly to airport #3. Return to airport #2 to refuel for the flight back to airport #1.

You may cross the mountain range through the "high pass" on the north-south section of the range or through the "Z pass" on the east-west section. If you fly through the "high pass", note that climbing up to 2880 feet consumes a considerable portion of your fuel, and you should fly directly to airport #2 the most direct way you can. If you fly through the "Z pass", you will have to use considerable flying skill to keep from smashing into the side of the canyon. Before entering the canyon, it may help to slow down by dropping the landing gear and/or adding 10 degrees of flaps. Be careful not to descend below 1000 feet.

ADF stations A and B will assist you when flying through either the "Z" pass or the "high pass", but following the ADF will not ensure that you won't hit the mountains, so consult the INS as you get close.

The approach to airport #4 is a bit tricky, as the north-south section of the mountain range begins right off the west end of the runway. Land from the east. It is possible to approach from the east, touch and go, take off, and turn . . . fast . . . towards the south. Otherwise, stop, turn around using the nosewheel steering, and take off to the east.

If you are landing at airport #4, and overshoot the runway, turn fast toward the south. Note that the 600 foot high ridge is just north of the airport, so you can't turn that way.

If you fly a back course localizer approach to airport #1, the glide slope intersects the 600 foot high ridge to the north. So, when you fly this approach, keep above 600 feet until N is below 75.

You should not need to use flaps unless you have entered a higher skill level. For instance, at skill level 9, your maximum landing speed is 65 mph. Any higher than that, and you will bounce. Use flaps to lower your stall speed and land slower.

When flying ILS approaches, use the trim to place the aircraft in a descent rate which matches the ILS glideslope, instead of "chasing" the bar using the stick.

If you run out of fuel in both tanks, you will have to land 'dead stick'. Set up a glide at about 80 mph, with the landing gear up. If you are near enough to an airport, turn toward it and try to land. Remember, to receive full fuel, you have to stop on the runway of airport #1 or #2. Keep in mind that you don't have to land the long way of the runway, so you can land off runway and try to coast onto the runway from the ends or sides. Keep your landing gear up until just before touchdown.

When out of fuel, the airplane will sink faster because of the drag of the "windmilling" propeller, so be prepared to pull back on the stick earlier than on a normal landing. Don't forget the landing gear!

If you want to practice 'dead stick' landings, use the editor to set up at 600 feet, and enter .5 for left fuel and 24 for right fuel. When the flight begins, the left fuel tank will run out within a minute. Make your 'dead stick' landing, then switch fuel tanks, start the engine, and take off.